



2011

Chemistry of the Matfield River

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A scenic view of the Matfield River in East Bridgewater, MA. The foreground shows turbulent, white-water rapids flowing over rocks. In the middle ground, a stone bridge with multiple arches spans the river. The background is filled with dense trees displaying vibrant autumn foliage in shades of yellow, orange, and green. A small white house is visible on the left side of the background. The sky is overcast and grey.

CHEMISTRY OF THE MATFIELD RIVER, EAST BRIDGEWATER, MA

Getting to the site



Stream Chemistry

Chemistry data collected from the Matfield:

- Dissolved oxygen
- Temperature
- pH
- Conductivity
- Nitrate & Phosphate concentration

The Matfield River

What can we learn from it?

- How to collect field data
- How to analyze and interpret the data
- Learn chemistry and its application

Dissolved Oxygen

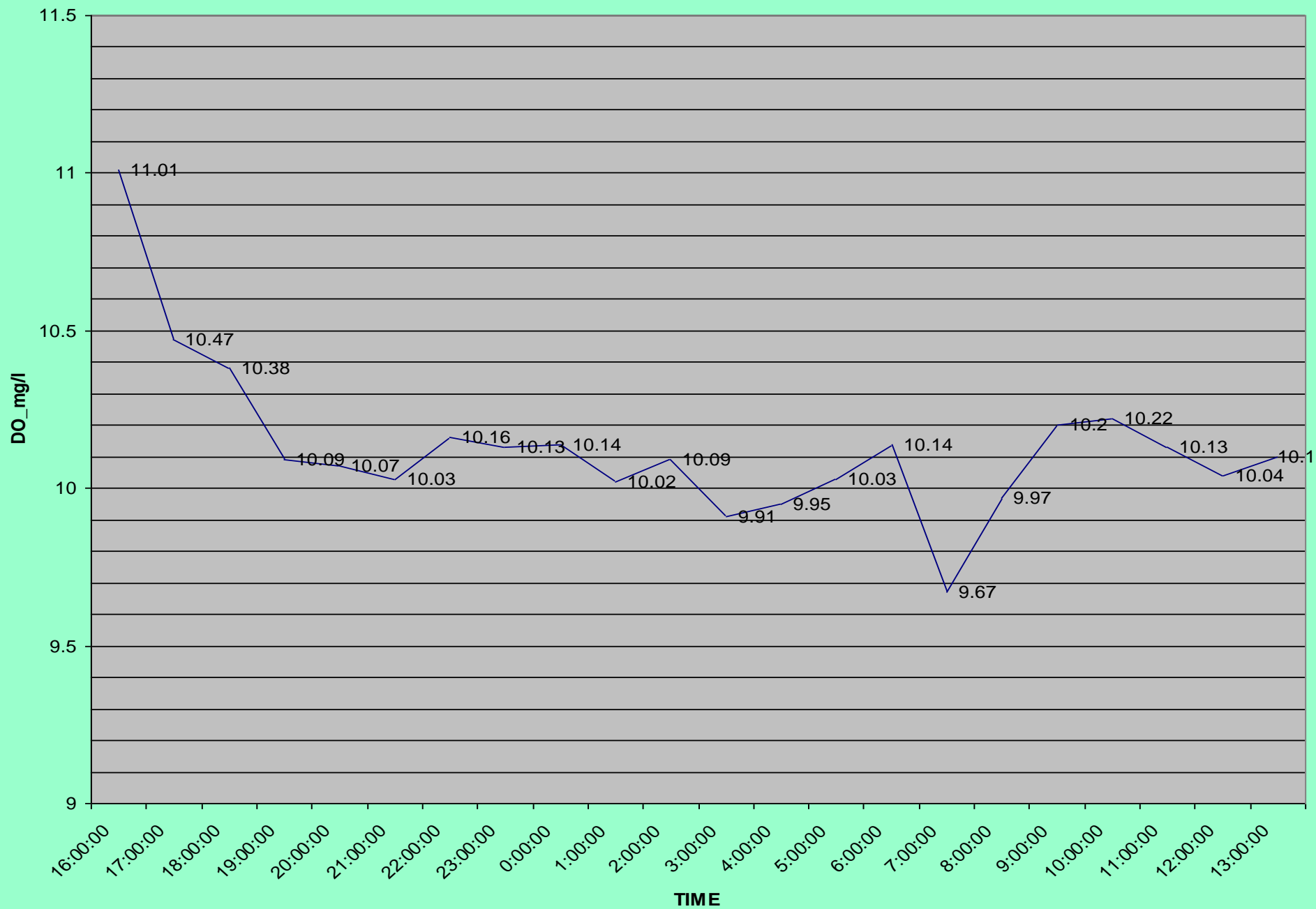
- Dissolved oxygen is a gas dissolved in water.
 - Dissolved oxygen is important because it tells us what can live in the water.
 - It is measured in milligrams per liter.
 - Saturation: The greatest concentration of oxygen that can be dissolved in water at a given temperature.
- % saturation = $\frac{\text{mg/L DO measured}}{\text{mg/L DO for saturation}} \times 100$
- mg/L = parts per million
- Oxygen diffuses into the water in streams both day and night as water travels over the rocks.



What Affects Dissolved Oxygen

- Temperature affects the amount of oxygen that can be dissolved at any time. Generally as the temperature rises, the amount of dissolved oxygen decreases.
 - For our data, the highest temperature was 13.64°C with 106.7 % saturation.
- If algae and plants are abundant, the dissolved oxygen level is higher during the daytime and lower at night and that is known as diurnal variation.

Matfield River, East Bridgewater MA, November 9, 2010



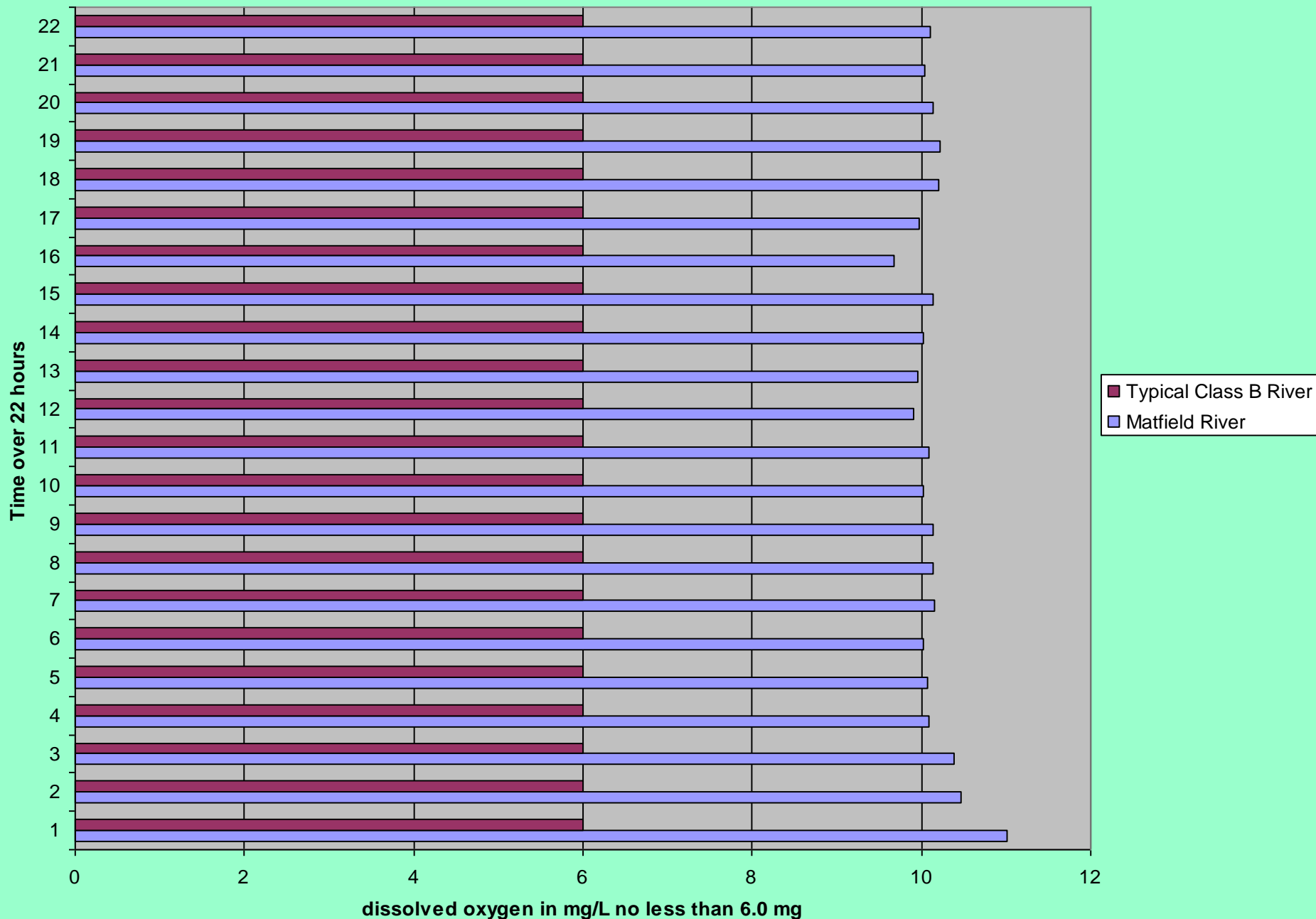
What Dissolved Oxygen Affects

- Dissolved oxygen affects what kind of species and organisms are found in the water.
- Many organisms can't live where there is low oxygen and warm temperatures.
- Salmon and trout have to live in water that has a dissolved oxygen level above 7 ppm.
- A 4 ppm (or below) dissolved oxygen level indicates a pollution problem.
- A difference of 2 or 3 ppm could mean life or death for the organisms and species in the water.

Classes of Rivers

- A class A river is a river that is a source of drinking water.
- A class B river is a river used for recreation.
- A class A river can't have the dissolved oxygen level at anything less than 6.0 mg/L. Our data doesn't have any level less than 9.67 mg/L.
- A class B river can't have the dissolved oxygen level below 5.0mg/L for a wwf.
- Class A can't have saturation levels below 75% saturation. Class B can't be below 60% saturation for a wwf.
- Our data doesn't have any level less than 91.6% saturation.

Matfield River, East Bridgewater MA, November 9, 2010



What is pH?

pH is the measurement
of acidity in a solution



pH levels : what it means

- The pH level of a solution tells us whether a solution has an excess concentration of Hydrogen protons. Hydrogen protons come from acids such as Hydrochloric acid, Acetic Acid, Sulfuric Acid, and Carbonic Acid.
- Having a high pH level means...
 - that it is alkaline, its basic.
 - hydrogen ions are being taken out of solution.
- Where is the middle?
 - seven is neutral, its not an acid or a base.
- Having a low pH level means...
 - Its acidic
 - When it is lower than 7 it is acid.
 - Excess concentration of Hydrogen ions are in the water.
- The pH range for a Class B river in Massachusetts is 6.5 - 8.2.



pH Background Information



What affects pH?

- air pollution □ causes decrease in the pH of precipitation, acid rain.
- large amounts of snow □ acidic snow melts into water sources

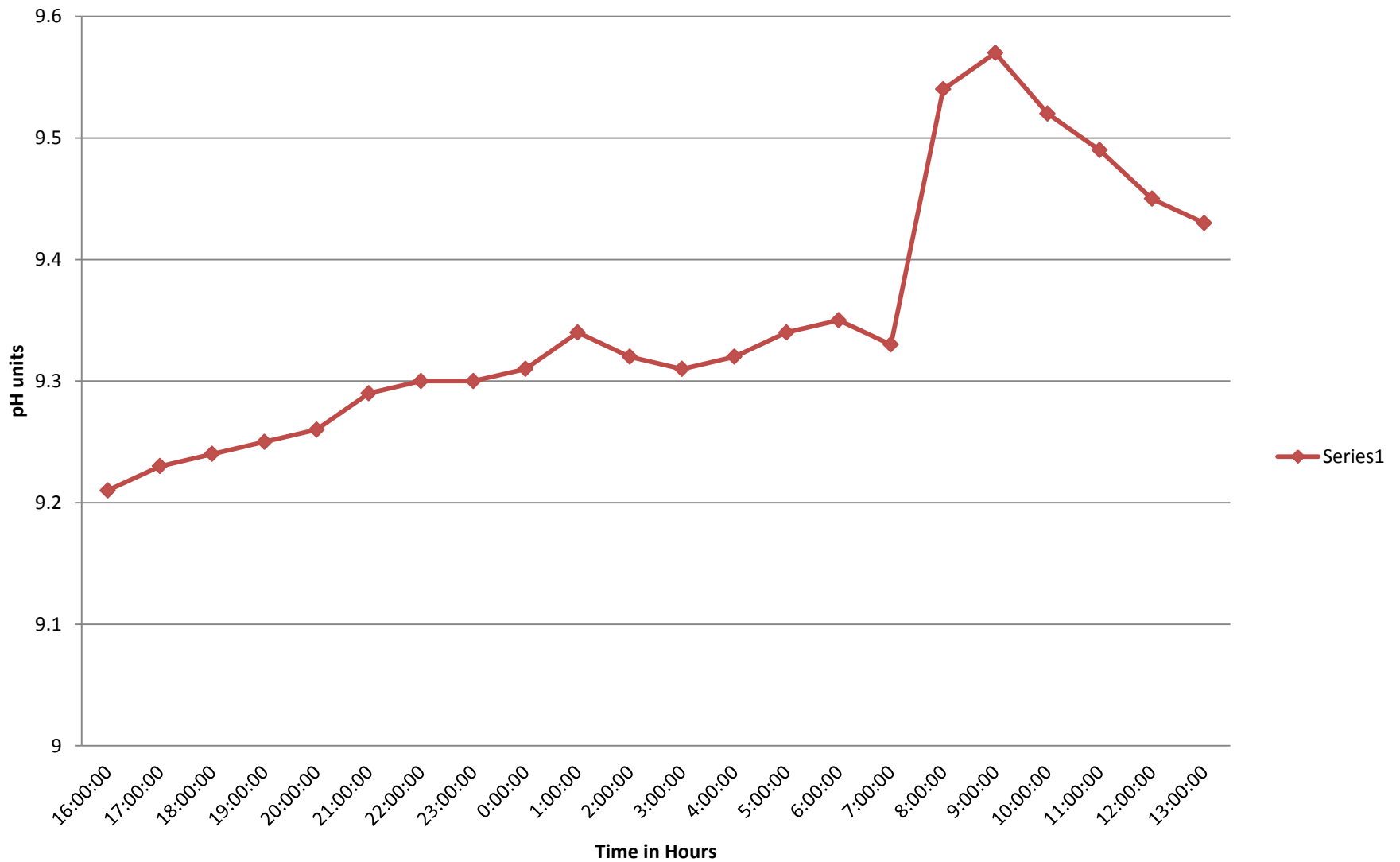


What does pH affect in the river?

- it affects aquatic organisms living in the river
- it affects whether or not the bedrock in the river neutralizes the acid rain flowing into the river

East Bridgewater, Matfield River, 11/09/10

pH Versus Time



Is there a pattern in the graph?

- no distinct, recognizable patterns. The only observation we have is that the graph does not rise / fall equally.

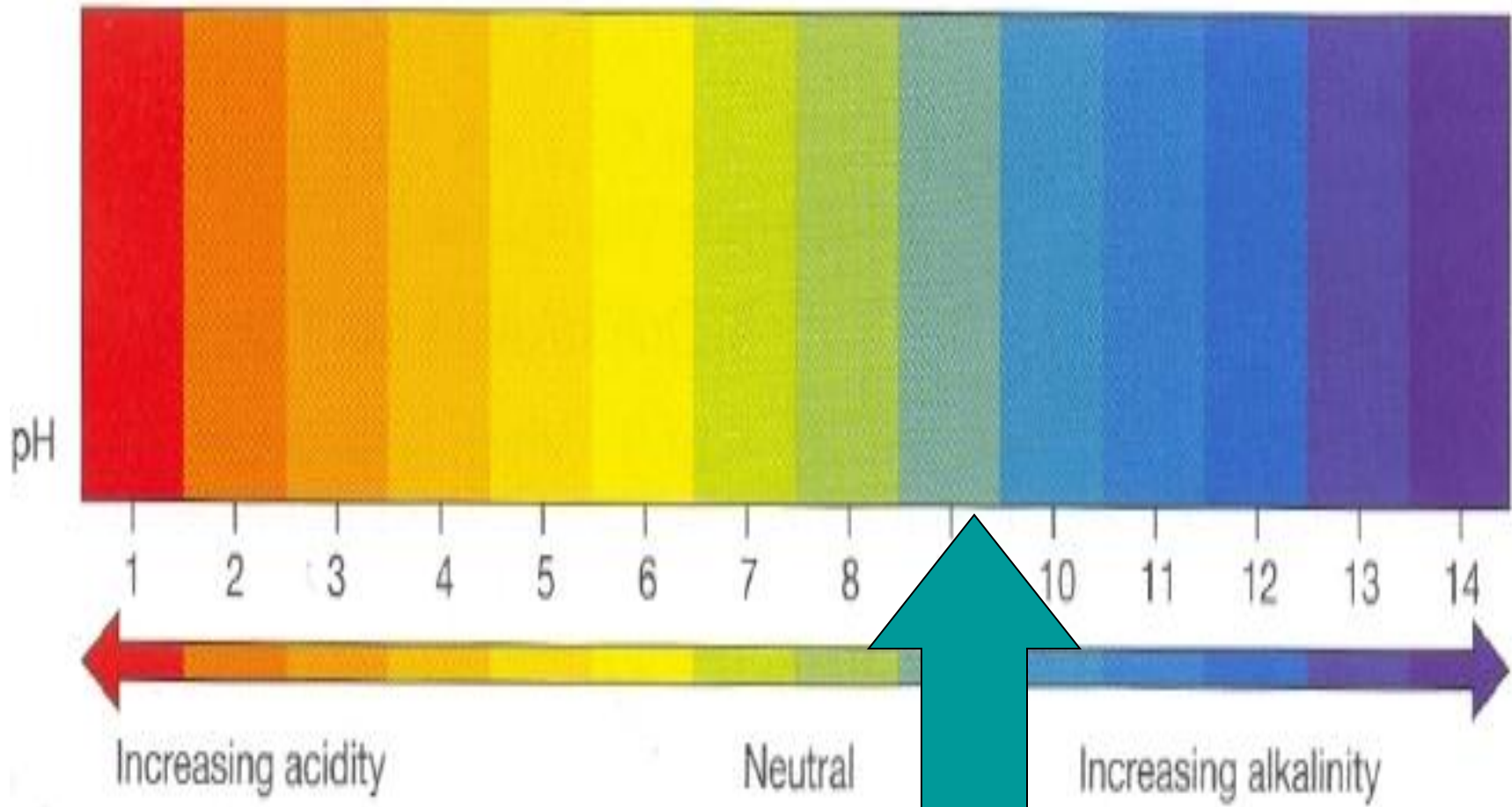
- peaks @

- 2:00 am
- 7:00 am
- 9:00 am
- 10:00 am
(highest)

drops @

- 2:00 am □ 5:00 am
- 6:00 am □ 7:00 am
- □ 10:00am



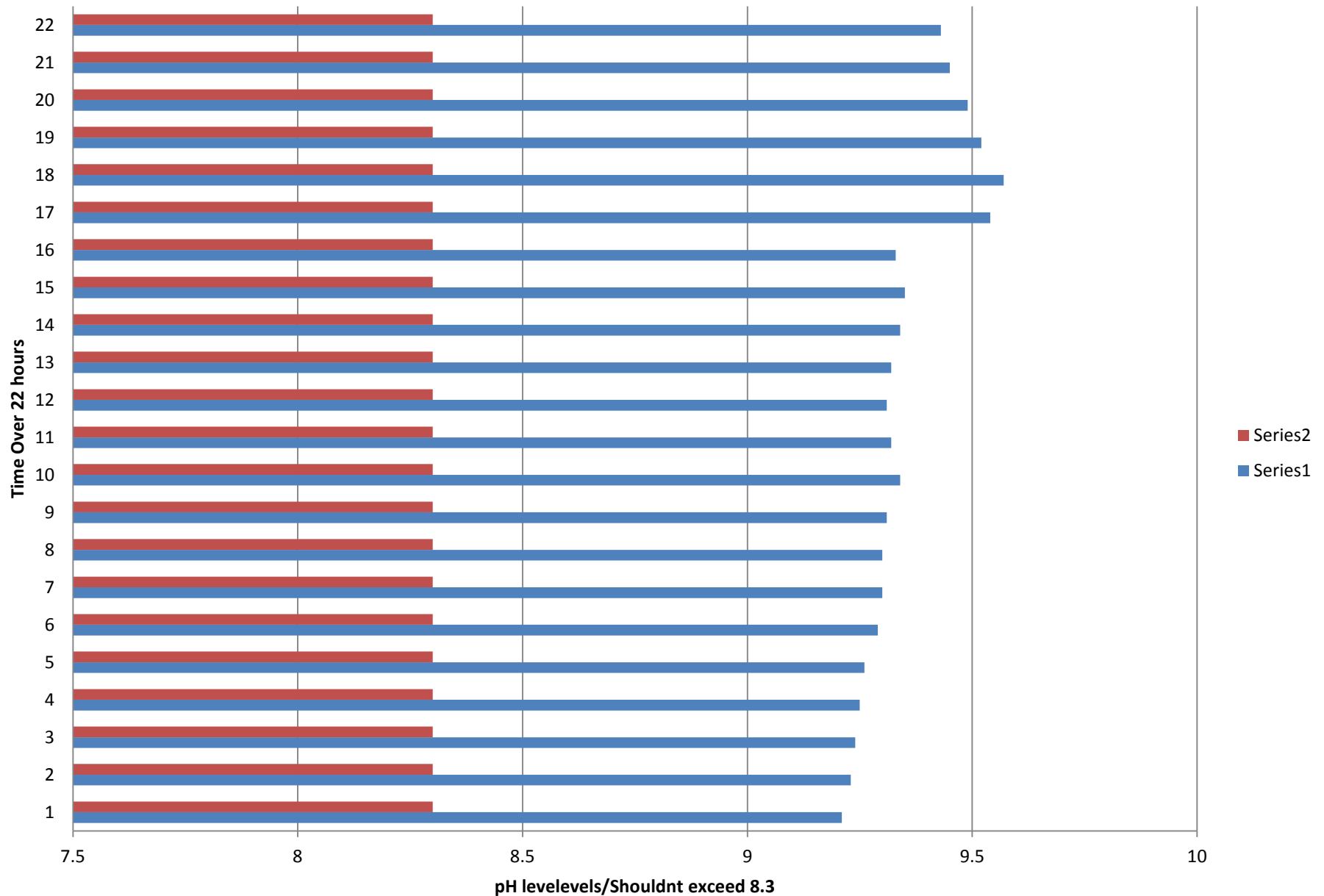


Our pH level is a little high.
Our average pH level is 9.35

WE ARE HERE

East Bridgewater Matfield River 11/09/10

pH levels compared to permitted levels/Shouldn't exceed 8.3



As shown in the graph.... (average pH measurements)

- Our level of pH is higher than the acceptable pH level of a class B river
- A class B river has the highest acceptable pH level of 8.3, the data from our site has an average pH of 9.35.
- The pH level is 1.05 over the limit of a class B river.



Alkalinity

- Alkalinity is the ability of a river to neutralize an acid.
- It is not directly affected by pH, but rivers with a high alkalinity are able to withstand higher pH levels.
- Alkalinity is the measurement of negative ions such as hydroxide (OH^-), carbonate (CO_3^{2-}), and bicarbonate (HCO_3^-) dissolved in water.

Buffering

- A solution that is buffered is able to resist changes in H even when a strong acid or base is added.
- Buffering is caused by the presence of weak acids or weak bases.
- The weak acids/bases cancel out any strong acids/bases added to solution.
- Buffering is vital in maintaining pH levels healthy for pH sensitive organisms.



Nitrates and Phosphates

& Conductivity

& Conductivity



- Nitrates and nitrites are families of chemical compounds containing atoms of nitrogen and oxygen. Nitrate is always found in very small amounts because of the ongoing cycles of growth and decay.
- In healthy, balanced ecosystems, bacteria turns ammonia into nitrate.
- 88% of the nitrates that enter the nations waterways come from nonpoint source pollution. (because their source is often difficult to pinpoint or control from a single location)
- Excessive nitrates entering a lake or stream will cause massive growth of algae and other plant life in the water. (this “bloom” can cause water to become murky and raise its temperature)
- Many organic pollutants, however, such as sewage or manure, contain much higher levels of nitrate than those found naturally in streams

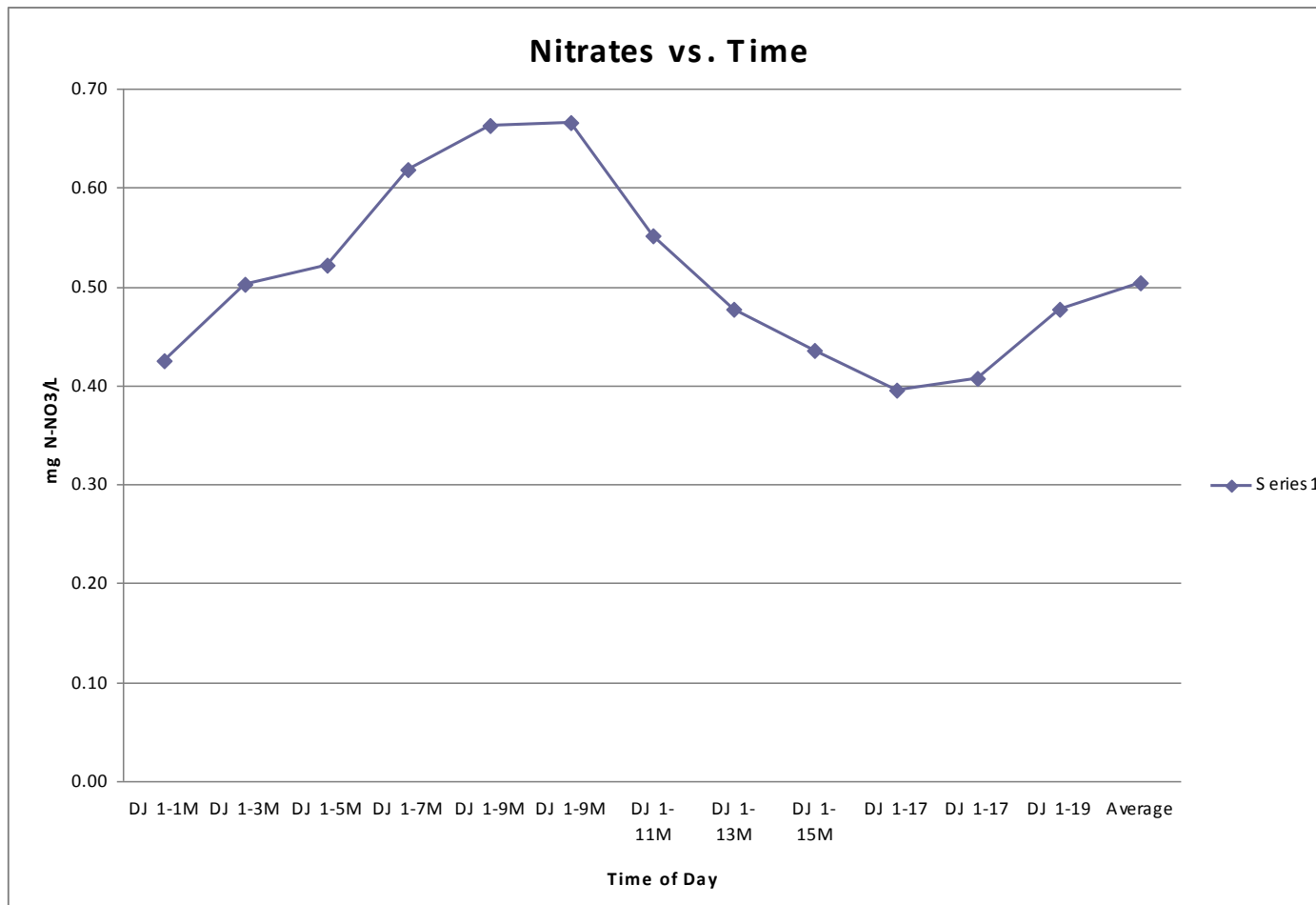
Phosphates

- **Phosphates, which contain phosphorus, are another plant nutrient that occurs naturally in low levels in the environment as part of the ongoing nutrient cycle.**
- **They originate from many sources, of which detergent is one of the most common(many manufacturers have reduced the amount of phosphates that are out into detergent)**
- **84% of the phosphates entering the nation's surface water are from nonpoint sources**
- **Phosphates can cause problems in aquatic ecosystems at levels as low as 0.5 ppm**

Matfield River, East Bridgewater, MA

Nitrogen Nitrate (N-NO₃)

November 9, 2010

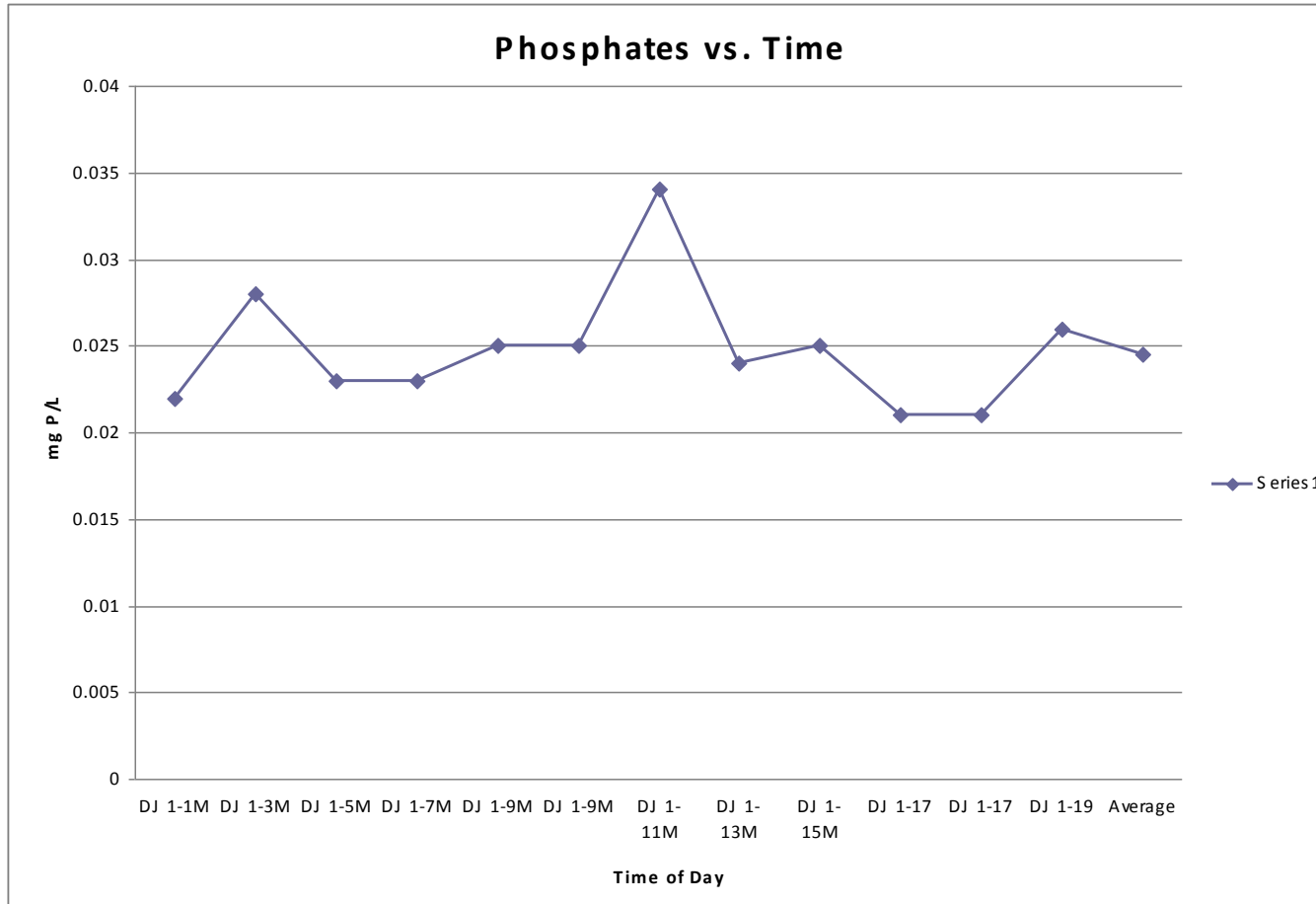


-machine detection limit is .1 mg/L

-class A water std: N-NO₃ < 1.0mg/L

Soluble Reactive Phosphorous (SRP)

November 9, 2012



-machine detection limit is .008 mg/L

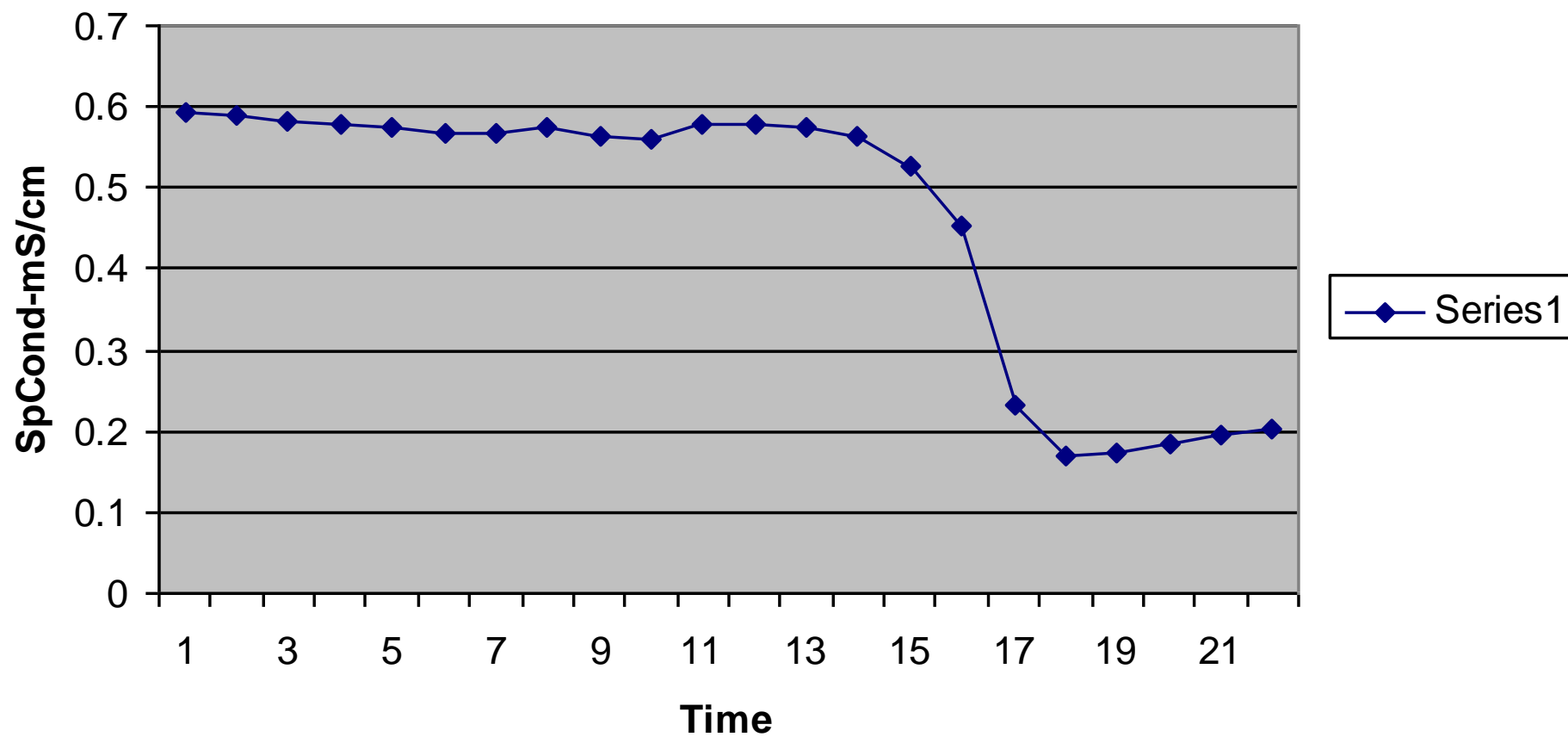
-Class A water standard: SRP < .1 mg/L

In General

- Conductivity is a measure of the ability of water to pass an electrical current.
- Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge).
- Conductivity is affected by temperature. The warmer the water the higher the conductivity.
- Conductivity in streams and rivers is affected by the geology of the area through which the water flows.

HYDRO LAB DATA

Sp Cond_mS/cm	0.168-0.593	0.566	0.515
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Time vs. Conductivity

Natural conductivity level without human influence would be found 0.05 Ms/cm or less (EPA)

In the Matfield River

- At 16:00, conductivity was about .58 mS/cm.
- Mid-way thru the day, at 3:00, conductivity was still at about .58 mS/cm.
- At 9:00 AM, conductivity dropped dramatically from about .58 mS/cm to about .17 mS/cm at the lowest.
- For the rest of the day, conductivity stayed at about .17 mS/cm or higher.

What does this mean?

- The conductivity dropped dramatically at 9 in the morning.
- We are not sure what this could mean and we would have to do further research or conduct another experiment such as going to the same river at a different time of year and comparing the two sets of data. Another option is to go to another river in East Bridgewater and conduct the same experiment; then compare the two sets of data.

Temperature

- What is Temperature?
- What affects the temperature of a river?
- What does temperature have an effect on?
- What does the temperature tell you about the quality of the water?
- Are the temperature readings from a 22 hour period significant?

What is temperature?

- Temperature is a measure of molecular vibrational energy
- The measures of temperature are recorded in °C
- The temperature recordings of the river water were taken by a hydrolab instrument every hour for a 22 hour period



What affects temperature?

- Vegetation - streamside vegetation can create shade that cools the temperature, our river was surrounded by trees
- Depth - shallower water is warmer than deeper water
- Outside water sources - ex. Runoff or groundwater that enters the river can make the river warmer
- Color – dark colored water (created by mud) absorbs more heat
- Location – the surrounding climate can affect temperature (ex. A river in Canada would be colder than one in Brazil)
- Time – the time of year and the typical surrounding temperatures for that season can affect water temperature, our data was taken in November

What does temperature affect?

- Dissolved Oxygen - more oxygen can be dissolved in colder water than warm water
- Dissolved phosphates and nitrates – solids such as phosphates and nitrates dissolve more easily in warmer water
- Photosynthesis – increased temperatures cause an increase in photosynthesis if there are sufficient nutrients

Hydro Lab Data

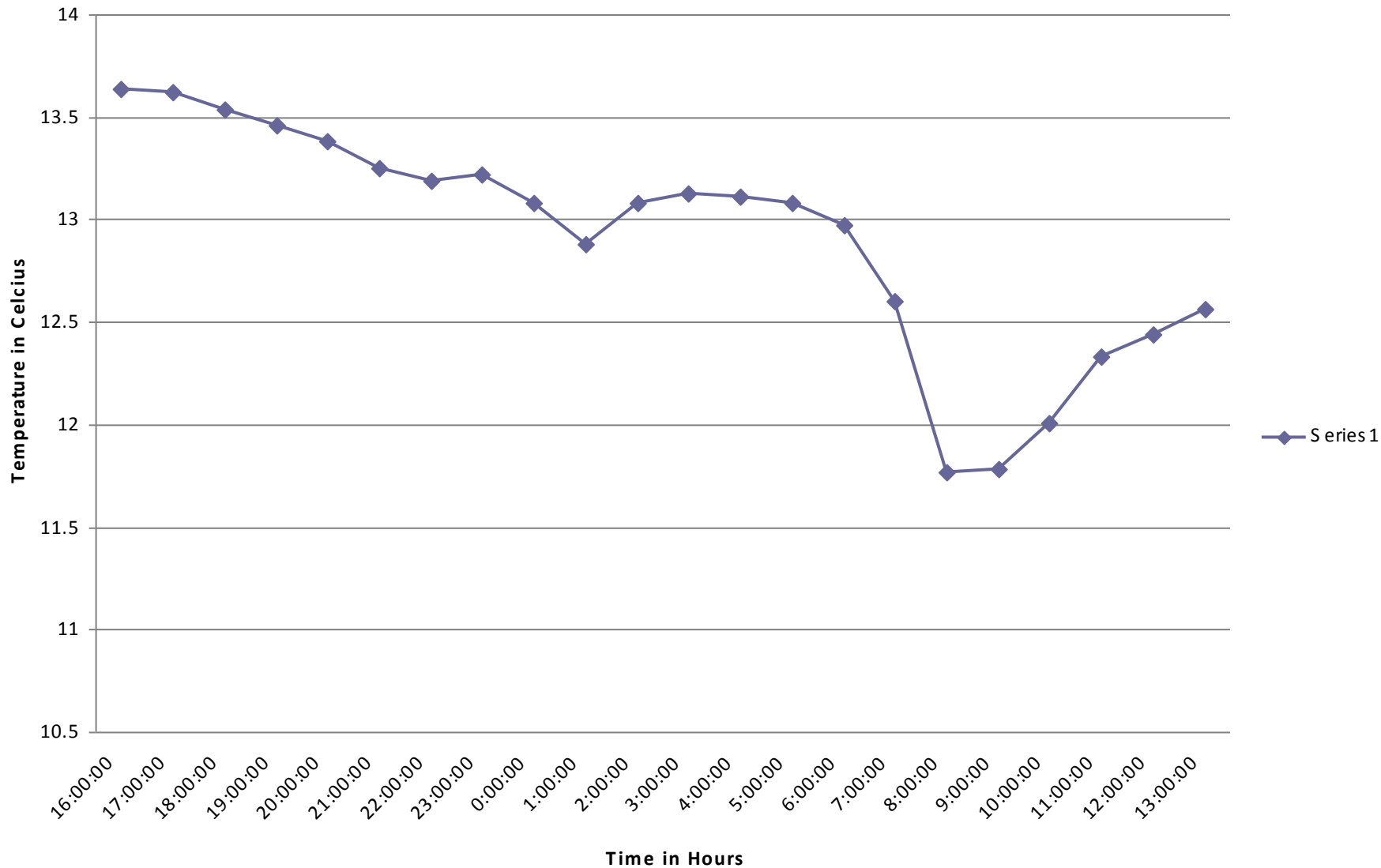
Matfield River

November 16 and 17, 2010

				Range		Median	Average
	Temperature_°C			11.77-13.64		13.08	12.91
	pH_Units			9.21-9.57		9.32	9.77
	Dissolved Oxygen_mg/L			9.67-11.01		10.09	10.13
	% Saturation DO			91.6-106.7		96.25	96.67
	Sp Cond_mS/cm			0.168-0.593		0.566	0.515

Matfield River, East Bridgewater November 9, 2010

Temperature Versus Time Josh Murphy



The Matfield River

- Throughout the 22 hour period that temperature, the range of temperatures was 11.77- 13.64 °C
- The temperature data collected for this river is comparable to that of a Class B river because in a Class B cold water fishery the temperature cannot exceed 20 °C and our average temperature was 13.08 degrees

Presented by:

Nicole Abbot

Ryan Amadea

Kayla Berry

Rachel Blauner

Jared Burns

Shaelyn Casey

Marissa Coe

Brandyn Evora-Rosa

Kayla Hogan

Bridget Irving

Megan McCarthy

Lindsay Montville

John Moura

Sarah Stetler

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